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TECHNICAL MEMORANDUM

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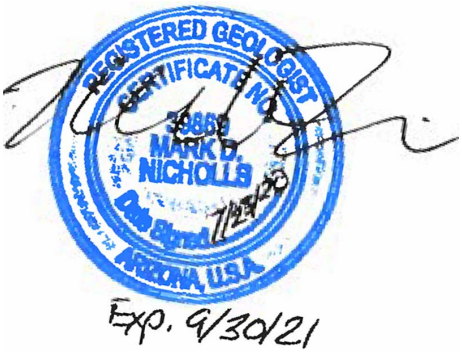

TO: Florence Copper Inc.
Richard Tremblay, Vice President Operations

FROM: Haley & Aldrich, Inc.
Mark Nicholls, R.G.

SUBJECT: Response to Request for Additional Information Regarding Proposed Production Test Facility Rebound Monitoring

Introduction

This Technical Memorandum provides responses to a request for additional information received by telephone from the Arizona Department of Environmental Quality (ADEQ) on 20 July 2020. The request for information was made by ADEQ following submittal of a Technical Memorandum titled *Summary of Potential Post-Rinsing Water Quality Rebound Effects at the PTF Wellfield*, and dated 16 July 2020.

The specific questions asked by ADEQ following review of the 16 July Technical Memorandum were:

1. Regarding laboratory leaching and rinsing analysis of the Production Test Facility (PTF) core samples:
    a. Did laboratory analyses conducted by Florence Copper Inc. (Florence Copper) include the parameters outlined in Table 14 of the Draft Aquifer Protection Permit (APP)?
    b. Was the rinsing in the lab successful in achieving desired Aquifer Water Quality Standards (AWQS) water quality?
2. Regarding the timing for PTF post-rinsing monitoring:
    a. Why was 30 days proposed as the period for post-rinsing monitoring?

During a conference call on 22 July, Florence Copper provided information to ADEQ which addressed questions 1a and 1b above. During that call, ADEQ accepted that the verbal answers provided were sufficient. The response to question 2 is provided below.

Duration of the PTF Post-Rinsing Monitoring Period

In the 16 July Technical Memorandum, Florence Copper proposed to monitor rebound conditions at the PTF wellfield for a period of 30 days after the last PTF well has met the permit closure criteria for sulfate, pH, and AWQS constituents listed in the Draft APP. This period of monitoring is appropriate for the following reasons:

1. Experience with the BHP wellfield has shown that the ISCR wells at the outer edge of the wellfield will achieve the closure criteria long before the final well achieves the closure criteria. This provides a long period of time to evaluate potential rebound at the early wells prior to the final well achieving the closure criteria and entering the 30 day rest period.
2. The principal chemical reactions (dissociation of latent acid compounds) that govern the potential for rebound of dissolved constituents take place very quickly and will be evident within a short period of time (on the order of hours) following the cessation of hydraulic control pumping. Monitoring indicators of these reactions will provide an indication of the potential for rebound during the proposed 30-day rest period.

Each of these subjects are described below.

REBOUND MONITORING WHILE RINSING IS ONGOING

There are 20 PTF wells that will be monitored during formation rinsing. Experience with the BHP wellfield has shown that the ISCR wells at the outer edge of the wellfield will achieve the closure criteria long before the final well achieves the same criteria. The proposed 30-day post-rinsing monitoring period will begin after the final PTF well achieves the closure criteria established in the APP. By the time this occurs, the other 19 PTF wells will have met the closure criteria for various lengths of time, and some of the wells may have met the criteria for a year or more. Rebound monitoring effectively begins at each PTF well once the closure criteria are achieved (first sulfate, then metals) at that well.

Based on BHP's rinsing experience, the first of the wells to achieve the sulfate closure criteria (750 mg/L) did so after approximately 120 days of rinsing. Additional wells met the criteria within 180 days of the start of rinsing. The last wells (at the center of the wellfield) achieved the sulfate closure criteria after approximately 21 months of rinsing. Based on this experience, several of the PTF wells may have more than a years' worth of rebound monitoring data before the final well achieves the closure criteria. These data will be used to evaluate and adjust the rinsing process, if necessary, as it is ongoing. The opportunity for rebound monitoring conducted at each of the wells achieving closure criteria early while rinsing is ongoing at the central PTF wells will provide ample data and time to evaluate the post-rinsing equilibrium of the residual solid-phase minerals at the early wells before the 30-day post-rinsing monitoring begins at the last well.

It is important to note that Florence Copper has already observed a similar rinsing pattern to that observed by BHP since the addition of acid was discontinued on 26 June 2020. Since that time, sulfate concentrations are reduced across the entire PTF wellfield and the outer PTF wells are showing changes in pH and sulfate concentrations in advance of the interior PTF wells. Florence Copper anticipates this

pattern to continue, similar to BHP's rinsing experience, resulting in the outer PTF well achieving closure criteria prior to wells at the interior of the wellfield.

REBOUND INDICATORS

The solubility of residual solid-phase minerals is directly governed by pH of the formation. Because the pH will be adjusted during the three-phase rinsing process, the only way for the pH of the formation to decrease after rinsing is by the dissolution of latent acid compounds in the formation. If latent acid, or acid generating potential, were to exist within the formation following neutralization, the pH will decrease, and metals and other constituents may be mobilized. Because the dissolution of latent acid compounds is very rapid, the 30-day post-rinsing period is sufficient time to determine if acid generating potential exists within the formation.

The oxidation of pyrite minerals (FeS2) is an example of acid generation potential within a copper orebody. Pyrite oxidation is a process which includes oxidation/reduction reactions, complexation and hydrolysis reactions, and solid/solution equilibria. The process is controlled by equilibrium aspects and kinetic effects under a given set of conditions. The overall reaction for pyrite oxidation may be written as:

$$2\ FeS_2 + 15/2\ O_2 + 4\ H_2O = Fe_2O_3 + 4\ H_2SO_4 \qquad [1]$$

The chemical reaction responsible for the formation of acid from pyrite requires three basic ingredients: pyrite, oxygen, and water. Given equation [1], two moles of sulfuric acid are generated for every mole of pyrite oxidized.

Under conditions anticipated during PTF rinsing (pH> 4.0 standard unit), oxygen is the only oxidant capable of creating acid generating conditions in groundwater by abiotic oxidation of pyrite. There are two chemical species that can oxidize from pyrite, the ferrous iron to form iron oxides and the sulfidic sulfur to form sulfuric acid. Acid drainage studies show that iron mobilizes out of pyrite almost immediately and tends to stay in the ferrous state in acidic solutions. Sulfur oxidizes even more rapidly than iron. The reaction rates listed in Table 1 show that initiation of pyrite oxidation to form acid occurs on the order of hours.

Table 1. Abiotic Reaction Rates for Sulfide Mineral Oxidation

Mineral / Oxidant	Abiotic Reaction Rate*
	mol m^{-2} s^{-1}
Pyrite / Oxygen	3.1 x 10^{-10}
Pyrrhotite / Oxygen	1.4 x 10-8
**Values cited from Nordstrom, D.K., and Alpers, C.N., 1999, Geochemistry of acid mine waters.*	

The PTF wells were designed and constructed to leach copper from the copper-oxide minerals within the injection zone. These minerals were formed partly as a result of the oxidation of pyrite minerals within the formation over many thousands of years. As a result of this supergene oxidation process, the

formation has very little pyrite remaining, and the formation is in equilibrium with regards to redox conditions prior to the commencement of leaching.

The formation pH is anticipated to be stable following the cessation of rinsing because, very little pyrite remains in the formation, there is no continuous source of oxygen to oxidize the remaining pyrite, redox equilibrium will be restored by the addition of amendments during rinsing, and no other acid generating minerals exist within the formation. The potential for acid generating conditions is readily detected through the monitoring of pH during the proposed rest period. The abiotic oxidation rate of acid producing minerals is rapid enough to be observed within 30 days.

The planned 30-day post-rinsing monitoring period is a sufficient timeframe to collect data describing geochemical equilibrium conditions in the wellfield that will be used to inform future rinsing and rebound monitoring activities. The most important parameters to monitor during the 30-day post-rinsing period are pH and sulfate. A 30-day timeframe allows for the collection of four weekly water quality sampling events, the results of which will provide a robust data set for input to the geochemical model. These data will be used to support geochemical modeling of long-term equilibrium of the residual solid phase constituents.

To account for all future closure activities, Florence Copper submitted a Closure Plan to ADEQ on 12 March 2019 as per Section 2.9.1 of the APP No. P-106360. Under this Closure Plan, more extensive rebound monitoring will occur prior to plugging and abandoning the wells once commercial operations are completed.

Please contact Mark Nicholls at 602.819.0913 with any questions you may have regarding the content of this Technical Memorandum.